

To: J. Sumlin ✓

Date: July 18, 1994

Location: Joliet

Copy to: R. H. Burns  
C. Redding  
R. B. Tabakin

From: R. D. Watts

Location: Garret Mountain

Extension: 3321

Subject: **SOLID WASTE DETERMINATION REQUEST**

Reference:

I am forwarding with the letter a copy of the report from American Engineering Testing, Inc. on their study of our Processed Silica for use as a Pozzolan. I have also included copies of Standard Specifications and Testing Methods from ASTM. These should be included with your Solid Waste Determination Request.

I also expect a letter from Concrete Material Resources, Inc. expressing interest in the material for inclusion with your request. I will fax this as soon as I have it.

*Bob*

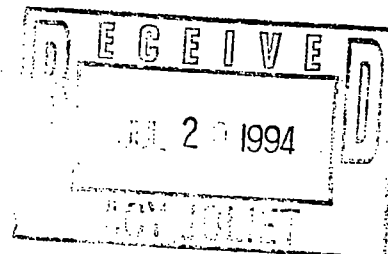
Robert D. Watts

RDW:kek/94071801.RDW  
ATTACHMENT(S)

RECEIVED

AUG 11 1994

PERMIT SECTION





AMERICAN  
ENGINEERING  
TESTING, INC.

CONSULTANTS  
• GEOTECHNICAL  
• MATERIALS  
• ENVIRONMENTAL

## REPORT OF POZZOLAN TESTING

**PROJECT:**

POZZAMENT EVALUATION

**REPORTED TO:**

CONSTRUCTION MATERIAL  
RESOURCES, INC.

1025 ASHWORTH ROAD

SUITE 210

WEST DES MOINES, IA 50265

**AET JOB NO: 94-939**

**DATE: JULY 12, 1994**

---

### INTRODUCTION

This report presents the result of our testing of Pozzament. We understand Pozzament is being considered for use in portland cement concrete and concrete masonry units. The scope of our work consists of laboratory batching concrete and making concrete masonry units at a commercial block plant using Pozzament. Tests of Pozzament, concrete, and concrete masonry units were included.

### CONCLUSIONS

Based on the results of our work and experience, it is our opinion the following conclusions are appropriate:

1. Pozzament meets the requirements of ASTM:C618 for a Type N pozzolan. It is suitable for use in portland cement concrete and concrete masonry products.
2. Pozzament concrete masonry units are 27% and 15% stronger than typical block at 7 and 28 days, respectively.
3. Pozzament addition rates of 50% of the cementitious component yield block meeting ASTM:C90 requirements.

"AN AFFIRMATIVE ACTION EMPLOYER"

2102 University Ave. W. • St. Paul, MN 55114 • 612-659-9001 • Fax 612-659-1379  
4431 West Michigan Street, Suite #4 • Duluth, MN 55807 • 218-628-1518 • Fax 218-628-1580  
1730 First Avenue • Mankato, MN 56001 • 507-387-2222 • Fax 507-387-6999

4. The Pozzament concrete block has low efflorescence potential and is lighter in color.
5. Pozzament concrete is comparable to MnDOT paving concrete at low addition rates (10% of cementitious material). The compressive strength at early ages is increased as much as 35% but lags as much as 40% at 28 days at high dosages (40% of total cementitious material). The set time of the concrete is reduced 1 to 2 hours.

### ENGINEERING REVIEW

Pozzolans are ancient building materials. The Romans mined volcanic ash from the Bay of Naples for use in mortar. When mixed with lime cementation occurs yielding a hard, durable material. The survival of many Roman structures attests to the quality of the binder.

Portland cement is a more recent building material, its patent issued in England in 1824. The binder formed when water is added to portland cement is calcium silicate hydrate. The binder is similar to that formed by the pozzolanic reaction of volcanic ash and lime. An interesting facet to cement hydration is the liberation of lime during cementation. This lime is available to form more binder should a pozzolan be present. The pozzolan will often improve density, imperviousness and strength.

The most common pozzolan used in concrete is fly ash. The material is produced during the burning of pulverized coal and current usage is about 8,000,000 ton per year. Fly ash generally contains 40 to 50% silica, the pozzolanic component of the fly ash. Pozzament contains nearly twice the silica content. Pozzament therefore has potential to create more binder than fly ash. Typical composition values are contained in Table I.

Pozzament is superior to fly ash for making concrete block using low pressure steam curing. Pozzament's enhanced cementation capability was demonstrated by the concrete masonry unit tests. When Pozzament was substituted for fly ash the compressive strength increased 15 to 27%. The reduction in efflorescence potential developed from two factors. Pozzament contains

little alkalis which are often leached from concrete block and form a stain. Also, the additional cementation consumes lime which can contribute to efflorescence.

Pozzament's performance in concrete is less effective than fly ash and is probably due to physical factors. The particle shape of Pozzament is angular due to crushing. Fly ash, however, is spherical. As a result, fly ash use reduces water demand for a given slump of concrete where Pozzament increases water demand. The water cementitious ratio of Pozzament concrete increased from 0.44 at 10% use to 0.50 at 40%. As expected, the compressive strength at 28 days dropped from 5720 psi to 3560 psi as a result. At low levels of Pozzament (less than 20%) results comparable to fly ash are achieved.

The difference in set time of the Pozzament concrete is probably due to the reactive nature of the amorphous silica. It is well known that fly ash will retard the set of concrete. Often accelerators are used to compensate for this undesirable feature. However, the high quantity of reactive silica present in Pozzament drives the cementation reaction more quickly. The behavior is similar to concrete containing microsilica.

### **TEST METHODS & RESULTS**

On April 4, 1994, Superior Minerals processed 25 tons of Pozzament for testing. A 1 cubic yard sack of the material was delivered for testing. The Pozzament was used to batch about 500 concrete blocks and 4 loads of concrete.

The concrete masonry units were made at a commercial block plant using a low pressure steam curing system. The 8" x 8" x 16" hollow core block were made using a Besser V-3-12 block machine. Three batches were run using 30%, 40%, and 50% Pozzament. The following proportions were used:

	1	2	3	Control
Portland Cement	70%	60%	50%	70%
Pozzament	30%	40%	50%	None
Fly Ash	None	None	None	30%
Sand/Cementitious Ratio	7.7	7.7	7.7	7.7

Block from each run were sampled and delivered to the laboratory for testing. Samples from the typical mix were also obtained for comparison.

The block were tested for conformance to ASTM:C90 "Standard Specification for Load-Bearing Concrete Masonry Units". The compressive strength, absorption, moisture content, density, and dimensions were determined following ASTM:C140 methods. Shrinkage testing is currently underway. Data sheets are attached containing the test data.

All the Pozzament concrete block meet ASTM:C90 requirements. The following is a summary of the data:

	1	2	3	Control
Block Weight, received, lbs	36.7	37.0	37.5	37.1
Density, pcf	136.3	136.6	138.1	136.4
Absorption, %	6.0	6.5	6.4	5.5
Moisture Content, % of absorption	43	50	50	27
Compressive strength, psi				
7-day	2,600	2,050	1,290	2,050
28-day	3,330	2,650	2,640	2,900

Four laboratory batches of Pozzament concrete were prepared in a 3 cubic foot mixer. The concrete was batched using MnDOT 3A41 proportions and a control concrete used for comparison. The following proportions were used:

	1	2	3	4	Control
Portland cement, pcy	531	472	413	354	501
Pozzament, pcy	59	118	177	236	None
Fly ash, pcy	None	None	None	None	89
Gravel, pcy	1,730	1,730	1,730	1,730	1,730
Sand, pcy	1,230	1,230	1,230	1,230	1,230
Air entrainment, ocy	5	5	5	5	5

Water was added to achieve a slump of 2½-4". Also the air entrainment was adjusted to create 4.5% to 5.5% air content. The plastic concrete was tested for slump, air content, unit weight, temperature and set time. Compressive strength cylinders were cast from the batches. Data sheets are attached containing the test data.

The Pozzament reduced the set time of the concrete 1 to 2 hours. The Pozzament water demand was greater than the control and increased with higher Pozzament use. The early age compressive strength is improved. However, strength at 28 days decreases with increase in Pozzament. The following is a summary of the data:

	1	2	3	4	Control
W/cm	0.44	0.46	0.47	0.50	0.42
Slump, in.	3½	3½	2¾	2¾	3¾
Air content	4.5	5.5	4.5	5.5	4.5
Temp (F°)	58.6	61.7	59.0	58.0	65.0
Unit Weight, pcf	145.2	143.0	145.2	142.9	145.5

## Set

Initial, hr, mn	3:35	3:50	3:30	4:10	5:20
Final, hr, mn	4:30	5:20	5:00	5:50	6:40

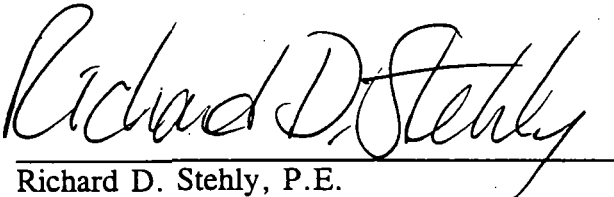
## Compressive Strength, psi

3-day	3,810	3,450	1,830	1,700	2,820
7-day	4,860	4,090	3,010	2,860	5,090
28-day	5,720	4,900	3,870	3,560	6,180
56-day	5,980	4,960	4,100	3,860	---

REMARKS

Shrinkage testing of concrete block is underway. The results will be forwarded when available.

The Pozzament sample was consumed during the test program.



Richard D. Stehly, P.E.

**TABLE 1**  
**POZZOLAN COMPOSITION**

CONSTITUENT	POZZAMENT	FLY ASH <sup>1</sup>	MICROSILICA <sup>2</sup>
Silica, Si <sub>2</sub> O <sub>3</sub>	89.0%	25-60	92-98%
Alumina, Al <sub>2</sub> O <sub>2</sub>	9.2%	10-30	0.5%
Iron Oxide, Fe <sub>2</sub> O <sub>3</sub>	0.4%	5-25	2.1%
Magnesium Oxide, MgO	0.02%	<5	0.3%
Calcium Oxide, CaO	0.02%	1-30	0.8%
Sodium Oxide, Na <sub>2</sub> O	<0.01%	<5	0.1%
Potassium Oxide, K <sub>2</sub> O	0.12%	<5	1.0%
Sulfur Trioxide, SO <sub>3</sub>	1.5%	<6	0.25
Titanium Dioxide, TeO <sub>2</sub>	1.7%	--	--

1. American Concrete Institute's Committee 226 Report "Use of Fly Ash in Concrete".
2. WR Grace's Engineering Bulletin on Force 10,000 Microsilica.



AMERICAN  
ENGINEERING  
TESTING, INC.

CONSULTANTS  
• GEOTECHNICAL  
• MATERIALS  
• ENVIRONMENTAL

### REPORT OF CONCRETE BLOCK TESTING

**PROJECT:**

POZZAMENT EVALUATION

**REPORTED TO:**

CONSTRUCTION MATERIAL RESOURCES  
1025 ASHWORTH ROAD, SUITE 210  
WEST DES MOINES, IA 50265

**AET JOB NO:** 94-939

**DATE:** JULY 11, 1994

Sample Number:	1A	1B	1C	Avg. Unit	ASTM Spec. C90	
					Individual 3 Units	Avg. of 3 Units
Block Type:	8" x 8" 16", 2 core stretcher					
Block Producer:	Amcon, St. Cloud					
Production Date:	May 26, 1994					
Pozzament Content:	30%					
Dimensions:						
Length, in:	15.5	15.5	15.5			
Width, in:	7.6	7.6	7.6			
Height, in:	7.6	7.6	7.6			
Face Shell, in:	1.25	1.25	1.25	1.25		1 1/4" min.
Web, in:	1.00	1.00	1.00	1.00		1" min.
Equivalent Web:	2.32	2.32	2.32	2.32		2 1/4" min.
Weight as received, lbs:	36.4	36.8	36.8			
Physical Properties:						
Moisture Content, %:	9.5	50.0	36.4			
Absorption, %:	5.8	6.2	6.1			max. 18%
Absorption, lb/ft³:	7.9	8.5	8.3	6.0		
Density, lbs/ft³:	136.1	137.5	135.3			
Strength:						
Total Load, lbs:	159,560	214,180	185,160			
Gross Area, in²:	117.8	117.8	117.8			
Gross Strength, psi:	1,360	1,820	1,570			
Net Area, in²:	61.3	58.9	61.3			
Net Strength, psi:	2,600	3,640	3,020	3,330	min. 1700	min. 1900
Age, days	7	28	28			

Report Prepared By:

  
Richard D. Stehly, PE

"AN AFFIRMATIVE ACTION EMPLOYER"

2102 University Ave. W. • St. Paul, MN 55114 • 612-659-9001 • Fax 612-659-1379  
4431 West Michigan Street, Suite #4 • Duluth, MN 55807 • 218-628-1518 • Fax 218-628-1580  
1730 First Avenue • Mankato, MN 56001 • 507-387-2222 • Fax 507-387-6999

## REPORT OF CONCRETE BLOCK TESTING

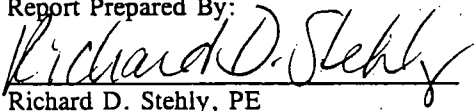
**PROJECT:**

POZZAMENT EVALUATION

**REPORTED TO:**CONSTRUCTION MATERIAL RESOURCES  
1025 ASHWORTH ROAD, SUITE 210  
WEST DES MOINES, IA 50265**AET JOB NO: 94-939****DATE: JULY 11, 1994**

Sample Number:	2A	2B	2C	Avg. Unit	ASTM Spec. C90	
					Individual 3 Units	Avg. of 3 Units
Block Type:	8" x 8" 16", 2 core stretcher					
Block Producer:	Amcon, St. Cloud					
Production Date:	May 26, 1994					
Pozzament Content:	40%					
Dimensions:						
Length, in:	15.5	15.5	15.5			
Width, in:	7.6	7.6	7.6			
Height, in:	7.6	7.6	7.6			
Face Shell, in:	1.28	1.28	1.28	1.28		1 1/4" min.
Web, in:	1.00	1.00	1.00	1.00		1" min.
Equivalent Web:	2.32	2.32	2.32	2.32		2 1/4" min.
Weight as received, lbs:	37.3	36.8	36.9			
Physical Properties:						
Moisture Content, %:	52.1	56.5	41.7			
Absorption, %:	6.4	6.5	6.7	6.6		max. 18%
Absorption, lb/ft <sup>3</sup> :	8.8	8.8	9.1			
Density, lbs/ft <sup>3</sup> :	138.2	135.9	135.8			
Strength:						
Total Load, lbs:	164,360	136,060	169,780			
Gross Area, in <sup>2</sup> :	120.8	120.8	120.8			
Gross Strength, psi:	1,360	1,130	1,410			
Net Area, in <sup>2</sup> :	59.2	59.2	59.2			
Net Strength, psi:	2,780	2,300	2,870	2,650	min. 1700	min. 1900

Report Prepared By:

  
Richard D. Stehly, PE

## REPORT OF CONCRETE BLOCK TESTING

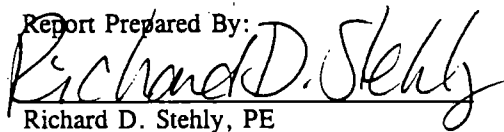
**PROJECT:**

POZZAMENT EVALUATION

**REPORTED TO:**CONSTRUCTION MATERIAL RESOURCES  
1025 ASHWORTH ROAD, SUITE 210  
WEST DES MOINES, IA 50265**AET JOB NO:** 94-939**DATE:** JULY 12, 1994

Sample Number:	3A	3B	3C	Avg. Unit	ASTM Spec. C90	
					Individual 3 Units	Avg. of 3 Units
Block Type:	8" x 8" 16", 2 core stretcher					
Block Producer:	Amcon, St. Cloud					
Production Date:	May 26, 1994					
Pozzament Content:	50%					
Dimensions:						
Length, in:	15.5	15.5	15.5			
Width, in:	7.6	7.6	7.6			
Height, in:	7.6	7.6	7.6			
Face Shell, in:	1.25	1.25	1.25	1.25		1 ¼" min.
Web, in:	1.00	1.00	1.00	1.00		1" min.
Equivalent Web:	2.32	2.32	2.32	2.32		2 ¼" min.
Weight as received, lbs:	37.5	37.6	37.5			
Physical Properties:						
Moisture Content, %:	50.0	54.2	45.5			
Absorption, %:	6.6	6.6	6.0	6.2		max. 18%
Absorption, lb/ft³:	9.1	9.1	8.3			
Density, lbs/ft³:	138.1	138.1	138.0			
Strength:						
Total Load, lbs:	149,800	155,750	161,560			
Gross Area, in²:	117.8	117.8	117.8			
Gross Strength, psi:	1,270	1,320	1,370			
Net Area, in²:	58.9	58.9	58.9			
Net Strength, psi:	2,540	2,640	2,740	2,640	min. 1700	min. 1900

Report Prepared By:



Richard D. Stehly, PE

## REPORT OF CONCRETE BLOCK TESTING

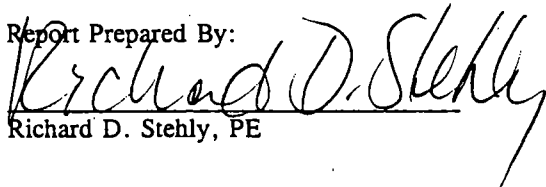
**PROJECT:**

POZZAMENT EVALUATION

**REPORTED TO:**CONSTRUCTION MATERIAL RESOURCES  
1025 ASHWORTH ROAD, SUITE 210  
WEST DES MOINES, IA 50265**AET JOB NO:** 94-939**DATE:** JULY 12, 1994ASTM Spec. C90

Sample Number:	Control A	Control B	Control C	Avg. Unit	Individual 3 Units	Avg. of 3 Units
Block Type:	8" x 8" 16", 2 core stretcher					
Block Producer:	Amcon, St. Cloud					
Production Date:	May 26, 1994					
Pozzament Content:	None					
Dimensions:						
Length, in:	15.5	15.5	15.5			
Width, in:	7.6	7.6	7.6			
Height, in:	7.6	7.6	7.6			
Face Shell, in:	1.25	1.25	1.25	1.25		1 ¼" min.
Web, in:	1.00	1.00	1.00	1.00		1" min.
Equivalent Web:	2.32	2.32	2.32	2.32		2 ¼" min.
Weight as received, lbs:	37.3	37.2	37.0			
Physical Properties:						
Moisture Content, %:	25.0	25.0	30.0			
Absorption, %:	5.4	5.5	5.5	5.5		max: 18%
Absorption, lb/ft³:	7.5	7.2	7.7			
Density, lbs/ft³:	137.5	132.4	139.4			
Strength:						
Total Load, lbs:	168,580	176,540	186,260			
Gross Area, in²:	117.8	117.8	117.8			
Gross Strength, psi:	1,430	1,500	1,580			
Net Area, in²:	61.3	63.6	58.9			
Net Strength, psi:	2,750	2,780	3,160	2,900	min. 1700	min. 1900
Age, days:	28	28	28			

Report Prepared By:



Richard D. Stehly, PE

## REPORT OF CONCRETE TESTING

**PROJECT:**

POZZAMENT EVALUATION

**REPORTED TO:**CONSTRUCTION MATERIAL RESOURCES  
1025 ASHWORTH ROAD, SUITE 210  
WEST DES MOINES, IA 50265

AET JOB NO: 94-939

DATE: JULY 12, 1994

**Mix Number:**

1

**Mix Design****Batch Proportions  
Adjusted for Yield**

Lehigh's Portland Cement, pcy	531	546
Pozzament, pcy	59	60
Shiely's Gravel, pcy	1730	1778
Shiely's Sand, pcy	1230	1264
Neutralized Vinsol Resin, ocy	5	3
Water	-	265
W/Cm	-	0.44

**Plastic Concrete Data**

Slump, in	3½
Air content, %	4.5
Temperature, °F.	58.6
Unit Weight, pcf	145.2
Set Time	
Initial Hr:Mn	3:35
Final Hr:Mn	4:30

**Compressive Strength, psi**

3-day	3810
7-day	4860
28-day	5680
	5760
56-day	5910
	6050

## REPORT OF CONCRETE TESTING

**PROJECT:**

POZZAMENT

**REPORTED TO:**

CONSTRUCTION MATERIAL RESOURCES  
1025 ASHWORTH ROAD, SUITE 210  
WEST DES MOINES, IA 50265

**AET JOB NO: 94-939****DATE: JULY 12, 1994**

---

**Mix Number:**

2

**Mix Design****Batch Proportions  
Adjusted for Yield**

Lehigh's Portland Cement, pcy	472	477
Pozzament, pcy	118	119
Shiely's Gravel, pcy	1730	1749
Shiely's Sand, pcy	1230	1243
Neutralized Vinsol Resin, ocy	5	5
Water	-	273
W/Cm	-	0.46

**Plastic Concrete Data**

Slump, in	3½
Air content, %	5.5
Temperature, °F.	61.7
Unit Weight, pcf	143.0
Set Time	
Initial Hr:Mn	3:50
Final Hr:Mn	5:20

**Compressive Strength, psi**

3-day	3450
7-day	4090
28-day	4830
	4980
56-day	4890
	5030

## REPORT OF CONCRETE TESTING

**PROJECT:**

POZZAMENT EVALUATION

**REPORTED TO:**CONSTRUCTION MATERIAL RESOURCES  
1025 ASHWORTH ROAD, SUITE 210  
WEST DES MOINES, IA 50265

AET JOB NO: 94-939

DATE: JULY 12, 1994

**Mix Number:**

3

**Mix Design****Batch Proportions****Adjusted for Yield**

Lehigh's Portland Cement, pcy	413	423
Pozzament, pcy	177	182
Shiely's Gravel, pcy	1730	1773
Shiely's Sand, pcy	1230	1260
Neutralized Vinsol Resin, ocy	5	7
Water	-	283
W/Cm	-	0.47

**Plastic Concrete Data**

Slump, in	2¾
Air content, %	4.5
Temperature, °F.	59.0
Unit Weight, pcf	145.2
Set Time	
Initial Hr:Mn	3:30
Final Hr:Mn	5:00

**Compressive Strength, psi**

3-day	1830
7-day	3010
28-day	3940
	3800
56-day	4140
	4060

## REPORT OF CONCRETE TESTING

**PROJECT:**

POZZAMENT EVALUATION

**REPORTED TO:**CONSTRUCTION MATERIAL RESOURCES  
1025 ASHWORTH ROAD, SUITE 210  
WEST DES MOINES, IA 50265**AET JOB NO:** 94-939**DATE:** JULY 12, 1994**Mix Number:** 4**Mix Design****Batch Proportions  
Adjusted for Yield**

Lehigh's Portland Cement, pcy	354	355
Pozzament, pcy	236	237
Shiely's Gravel, pcy	1730	1737
Shiely's Sand, pcy	1230	1234
Neutralized Vinsol Resin, ocy	5	11
Water	-	295
W/Cm	-	0.50

**Plastic Concrete Data**

Slump, in	2¾
Air content, %	5.5
Temperature, °F.	58.0
Unit Weight, pcf	142.9
Set Time	
Initial Hr:Mn	4:10
Final Hr:Mn	5:50

**Compressive Strength, psi**

3-day	1700
7-day	2860
28-day	3520
	3600
56-day	3800
	3930

## REPORT OF CONCRETE TESTING

**PROJECT:**

POZZAMENT EVALUATION

**REPORTED TO:**CONSTRUCTION MATERIAL RESOURCES  
1025 ASHWORTH ROAD, SUITE 210  
WEST DES MOINES, IA 50265

AET JOB NO: 94-939

DATE: JULY 12, 1994

**Mix Number:**

Control

**Mix Design****Batch Proportions  
Adjusted for Yield**

Lehigh's Portland Cement, pcy	501	515
National Mineral's fly ash, pcy	89	91
Shiely's Gravel, pcy	1730	1777
Shiely's Sand, pcy	1230	1264
Neutralized Vinsol Resin, ocy	5	3
Water	-	255
W/Cm	-	0.42

**Plastic Concrete Data**

Slump, in	3¾
Air content, %	4.5
Temperature, °F.	65
Unit Weight, pcf	145.5
Set Time	
Initial Hr:Mn	5:20
Final Hr:Mn	6:40

**Compressive Strength, psi**

3-day	2820
7-day	5090
28-day	6310
56-day	6040

## REPORT OF POZZOLAN TESTING

**PROJECT:**

POZZAMENT EVALUATION

**REPORTED TO:**CONSTRUCTION MATERIAL RESOURCES  
1025 ASHWORTH ROAD, SUITE 210  
WEST DES MOINES, IA 50265**AET JOB NO:** 94-939**DATE:** JULY 11, 1994**SAMPLE NO:** 1  
**SAMPLE SOURCE:** Superior Minerals  
**PRODUCT:** Pozzament  
**PRODUCTION DATE:** 4-4-94**CONFORMANCE:** The sample meets the requirement of ASTM C618-91 for a Type N pozzolan.**PHYSICAL PROPERTIES-ASTM:C311**ASTM:C618**Fineness**

Retained on #325 sieve (%)	5.8	34 max.
----------------------------	-----	---------

**Pozzolanic Activity Index****With Portland Cement (%)**

Ratio to Control @ 7 days	77	75 min.
---------------------------	----	---------

Ratio to Control @ 28 days	93	
----------------------------	----	--

Water Requirement (% of Control)	107	115 max..
----------------------------------	-----	-----------

**Soundness**

Autoclave Expansion (%)	0.07	±0.8 max.
-------------------------	------	-----------

Specific Gravity	2.42	±5.0% of average
------------------	------	------------------

## REPORT OF POZZOLAN TESTING

**PROJECT:**

POZZAMENT EVALUATION

**REPORTED TO:**CONSTRUCTION MATERIAL RESOURCES  
1025 ASHWORTH ROAD, SUITE 210  
WEST DES MOINES, IA 50265**AET JOB NO:** 94-939**DATE:** JULY 11, 1994**SAMPLE NO:** 1  
**SAMPLE SOURCE:** Superior Minerals  
**PRODUCT:** Pozzament  
**PRODUCTION DATE:** 4-4-94**CONFORMANCE:** The sample meets the requirement of ASTM C618-91 for a Type N pozzolan.**PHYSICAL PROPERTIES-ASTM:C311**ASTM:C618

Silica, $\text{Si}_2\text{O}_3$	89.0%	
Alumina, $\text{Al}_2\text{O}_2$	9.2%	
Iron, $\text{Fe}_2\text{O}_3$	0.4%	
Total	98.6%	70% minimum
Sulfur, $\text{SO}_3$	0.9%	
Sodium Oxide, $\text{Na}_2\text{O}$	<0.1%	4% maximum
Potassium Oxide, $\text{K}_2\text{O}$	0.1%	
Total Alkalies as $\text{Na}_2\text{O}$	<0.1%	1.5% maximum
Moisture Content	0.3%	
Loss of Ignition	3.2%	10% maximum